

Gastrointestinal and external parasites of *Enicognathus ferrugineus* and *Enicognathus leptorhynchus* (Aves, Psittacidae) in Chile

Parasitas gastrointestinais e externos de *Enicognathus ferrugineus* e *Enicognathus leptorhynchus*
(Aves, Psittacidae) do Chile

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Abstract

Parasite species are important components of biodiversity, as they provide valuable information about host health, evolutionary relationships, population structures, trophic interactions, the existence of environmental stresses, and climatic conditions. With the aim of describing the parasites associated with parrots of the genus *Enicognathus* Gray 1840 from central Chile, thirteen austral parakeets, *Enicognathus ferrugineus*, and five slender-billed parakeets, *E. leptorhynchus*, were examined between September 2007 and March 2014. The prevalence of ectoparasites and endoparasites was 88.9% and 22.2%, respectively. On eleven of the *E. ferrugineus* (84.6%) analyzed, and on all of the *E. leptorhynchus* analyzed (100%), five feather mite species (*Pararalichus hastifolia*, *Genoprotolichus major*, *Protonyssus* sp., *Fainalges* sp., and *Eurydiscalges* sp.) were collected. On ten *E. ferrugineus* (76.9%) and two *E. leptorhynchus* (40%), the chewing lice *Heteromenopon macrurum*, *Psittacobrossus patagoni*, and *Paragoniocotes enicognathidis* were collected. The nematode *Capillaria plagiaticia* was collected from three *E. ferrugineus* (23.1%), and the nematode *Ascaridia hermaphrodita* was found in one *E. leptorhynchus* (20%). The presence of *C. plagiaticia*, *Protonyssus* sp., *Fainalges* sp., and *Eurydiscalges* sp. from the two *Enicognathus* spp. are new records for Chile and represent new parasite-host associations.

Keywords: Birds, mites, acarina, Phthiraptera, nematoda, parasites.

Resumo

Os parasitas são componentes importantes da biodiversidade, uma vez que fornecem informação valiosa sobre a saúde do hospedeiro, relações evolutivas, estruturas populacionais, interações tróficas, a existência de pressões ambientais e das condições climáticas. Com o objetivo de descrever parasitas associada com papagaios do gênero *Enicognathus* (Gray 1840) no Chile central, foram examinados entre setembro de 2007 e março de 2014 treze periquitos austrais *Enicognathus ferrugineus* e cinco periquitos de bico fino *E. leptorhynchus*. A prevalência dos ecto e endoparasitas foi de 88,9% e 22,2% respectivamente. Em onze *E. ferrugineus* (84,6%) e na totalidade dos *E. leptorhynchus* analisados (100%), coletaram-se cinco espécies de ácaros de pena (*Pararalichus hastifolia*, *Genoprotolichus major*, *Protonyssus* sp., *Fainalges* sp. e *Eurydiscalges* sp.); os piolhos *Heteromenopon macrurum*, *Psittacobrossus patagoni*, e *Paragoniocotes enicognathidis* foram coletados de dez *E. ferrugineus* (76,9%) e dois *E. leptorhynchus* (40%). Por outro lado, os nematódeos *Capillaria plagiaticia* e *Ascaridia hermaphrodita* foram isolados de três *E. ferrugineus* (23,1%) e de um *E. leptorhynchus* (20%). O achado de *C. plagiaticia*, *Protonyssus* sp., *Fainalges* sp. e *Eurydiscalges* sp. parasitando *Enicognathus* spp. corresponde ao primeiro relato dessas espécies de parasitas para no Chile e representam novas associações parasita-hospedeiro.

Palavras-chave: Pássaro, ácaro, acarina, Phthiraptera, nematoda, parasita.

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Introduction

The genus *Enicognathus* Gray, 1840 (Aves: Psittaciformes) is comprised of two species: the slender-billed parakeet, *E. leptorhynchus* Müller, 1776; and the austral parakeet, *E. ferrugineus* King, 1831, both of which are endemic to Chile. The former has been distributed from the Valparaíso Region (33° 3' 47" S, 71° 38' 22" W) to the Los Lagos Region (41° 28' 18" S, 72° 56' 12" O) (2004). Conversely, the austral parakeet inhabits both Chile and Argentina, ranging from the Metropolitan Region (33° 26' 16" S, 70° 39' 01" W) to Cape Horn (Region of Magallanes, 54° 56' 00" S, 67° 37' 00" W) in Chile, and from the province of Neuquén (38° 57' 06" S, 68° 04' 28" W) to Tierra del Fuego (54° 21' 43" S, 67° 38' 17" W) in Argentina; it is the parrot with the most southerly distribution in the world (DÍAZ, 2012).

These birds are of special concern for conservation given their recent population declines during the last century (COLLAR, 1997; DÍAZ, 2012; GOODALL et al., 1957). This situation renders these birds a priority, especially with regards to acquiring knowledge about their biology – including their parasites; nevertheless, scientific literature on this topic is scarce (CARNEIRO et al., 2012). In addition, because of their low population sizes, only those birds that have died by natural or accidental deaths can be examined for endoparasites. Previous investigations into the parasitic fauna associated with parrots of the genus *Enicognathus* revealed three major groupings of parasites: two roundworm species (Nematoda: Ascaridiidae); three chewing lice (Insecta: Phthiraptera); and two feather mites (Arachnida: Acarina: Astigmata). The nematode *Ascaridia hermaphrodita* Froelich, 1789, was found in slender-billed parakeets in Chile (GONZÁLEZ-ACUÑA et al., 2007) and *A. platyceri* Hartwich and Tscherner, 1979 in austral parakeets in Germany (HARTWICH & TSCHERNER, 1979). Both were found in birds kept in captivity. The chewing lice species *Heteromenopon macrurum* Eichler, 1952 was recorded on austral parakeets in Argentina and Chile (EICHLER, 1952), and on slender-billed parakeets in Chile (CICCHINO & GONZÁLEZ-ACUÑA, 2009). *Psittacobrossus patagoni* Price and Beer, 1968 was recorded on an Austral parakeet in Argentina and Chile (PRICE & BEER, 1968); *Paragoniocotes enicognathidis* Cicchino & González-Acuña, 2009 was found on austral parakeets in Argentina and on slender-billed parakeets in Chile (CICCHINO & GONZÁLEZ-ACUÑA, 2009). The pterolichid feather mite *Pararalichus hastifolia* (MÉGNIN & TROUESSART, 1884) was collected from austral and slender-billed parakeets (ATYEO, 1989b), while *Genoprotolichus major* (FAVETTE

& TROUESSART, 1904), first described as *Protolichus*, was found on austral parakeets, both of which were in Chile.

The objective of the present study is to document new records of gastrointestinal and external parasites for both *Enicognathus* species from central Chile.

Materials and Methods

Between September 2007 and March 2014, thirteen austral parakeets and five slender-billed parakeets from central Chile were received by the School of Veterinary Science of the University of Concepción (Concepción, Chile). Their causes of death were vehicle collisions and poaching. The birds were stored individually at –12 °C until their analysis. The date of reception, provenance, coordinates, and date of analysis for each individual bird are found in Table 1. Lice and mites were collected by visual inspection of feathers. Ectoparasites were preserved in 70% ethanol, and lice were cleared and mounted in Canada balsam (PALMA, 1978; PRICE et al., 2003). Mites were cleared in Nesbitt's solution for 72 hours at sub-boiling temperature, and they were finally mounted in Berlese's medium (KRANTZ & WALTER, 2009). To identify lice, the keys and descriptions of Eichler (1952), Price & Beer (1967, 1968), Castro & Cicchino (1996), and Cicchino & González-Acuña (2009) were used. Mites were identified using the keys proposed by Atyeo (1989a, b), Gaud & Atyeo (1996a, b), and Krantz & Walter (2009). For endoparasites, the dissection of birds, as well as the collection and preservation of helminthes, followed the methods of Kinsella & Forrester (1972). The identification of the endoparasites followed the keys of Freitas & Mendonça (1959), Yamaguti (1961), and Kajerová et al. (2004). The terms for prevalence, range, and mean intensity follow Margolis et al. (1982) and Bush et al. (1997).

All of the collected parasite specimens are stored in the collection of the Zoology Laboratory of the School of Veterinary Science of the University of Concepción, Chillán campus.

Results

Endoparasites were found in 22.2% (4/18) (two species of nematodes) and ectoparasites were found on 88.9% (16/18) of the examined birds (there were three species of chewing lice and six species of mites). Tables 2 and 3 summarize the data on the parasites found on the austral and slender-billed parakeets.

Table 1. Date of reception, origin, coordinates and date of analysis of *Enicognathus* spp.

Species of parrot	Date of reception	Origin (commune)	Coordinates	Number of individuals
<i>E. ferrugineus</i>	2013	Chillán	36° 36' S, 72° 07' W	3
<i>E. ferrugineus</i>	2009	Collipulli	37° 57' S, 72° 26' W	1
<i>E. ferrugineus</i>	Not specified	Not specified	Not specified	4
<i>E. ferrugineus</i>	2007, 2009, 2009, 2011	San Fabián	36° 33' S, 71° 33' W	4
<i>E. ferrugineus</i>	2012	Retiro	36° 03' S, 71° 46' W	1
<i>E. leptorhynchus</i> *	2014	San José de Maipo	33° 38' S, 70° 22' W	1
<i>E. leptorhynchus</i>	Not specified	Not specified	Not specified	4

*Origin from a Wildlife Rehabilitation Center, CODEFF.

Table 2. Summary of ecto- and endoparasites found on Austral parakeets *Enicognathus ferrugineus* from central Chile.

Parasite species	Prevalence (%)	Range	Mean intensity	Number of parasitized birds	Total parasites
Acari: Pterolichidae					
<i>Pararalichus hastifolia</i>	23.08	0-1	1	3	3
<i>Genoprotolichus major</i>	38.46	0-5	2.4	5	12
Pterolichidae gen. sp.	23.08	0-3	2.33	3	7
Acari: Xolalgidae					
<i>Protonyssus</i> sp.	23.08	0-8	3.33	3	10
<i>Fainalges</i> sp.	76.92	0-43	14.7	10	147
Acari: Psoroptoididae					
<i>Eurydiscalges</i> sp.	61.54	0-16	6	8	48
Phthiraptera: Amblycera					
<i>Heteromenopon macrurum</i>	61.54	0-12	3.36	8	29
<i>Psittacobrossus patagoni</i>	15.38	0-3	2.5	2	5
Phthiraptera: Ichnocera					
<i>Paragoniocotes enicognathidis</i>	76.92	0-14	5	9	45
Nematoda: Trichuridae					
<i>Capillaria plagiaticia</i>	23.08	0-36	14.67	3	44

Table 3. Summary of ecto- and endoparasites found on Slender-billed parakeets *Enicognathus leptorhynchus* from central Chile.

Parasite species	Prevalence (%)	Range	Mean intensity	Number of parasitized birds	Total parasites
Acari: Pterolichidae					
<i>Pararalichus hastifolia</i>	60	0-26	18.5	2	37
<i>Genoprotolichus major</i>	60	0-18	13.67	3	41
Pterolichidae gen. sp.	60	0-5	3	3	9
Acari: Xolalgidae					
<i>Protonyssus</i> sp.	40	0-14	11.5	2	23
<i>Fainalges</i> sp.	60	0-232	80.67	3	242
Acari: Psoroptoididae					
<i>Eurydiscalges</i> sp.	60	0-38	18.67	3	56
Phthiraptera: Amblycera					
<i>Heteromenopon macrurum</i>	20	0-1	1	1	1
<i>Psittacobrossus patagoni</i>	20	0-3	3	1	3
Phthiraptera: Ichnocera					
<i>Paragoniocotes enicognathidis</i>	40	0-7	4.5	2	9
Nematoda: Ascaridiidae					
<i>Ascaridia hermaphrodita</i>	20	0-5	5	1	5

Two nematode species were found: *A. hermaphrodita* (Figure 1) was found in slender-billed parakeets, and *Capillaria plagiaticia* Freitas and Mendonça, 1959 (Figures 2, 3) in austral parakeets.

Three species of chewing lice (Phthiraptera) – *H. macrurum* (Figures 4, 5), *P. patagoni* (Figure 6), and *P. enicognathidis* (Figures 7, 8) – were found on austral parakeets and slender-billed parakeets.

Two species of mites (Astigmata: Analgoidea and Pterolichoidea), *P. hastifolia* (Figures 9, 10) and *G. major* (Figures 11, 12), and the three genera, *Protonyssus* sp. (Figures 13, 14), *Fainalges* sp. (Figures 15, 16) and *Eurydiscalges* sp. (Figures 17, 18), were found on the two parakeets.

Discussion

Nematoda

Seven species of the genus *Ascaridia* Dujardin, 1845 (Nematoda: Ascaridiidae) have been reported from the order Psittaciformes. Among these, *A. hermaphrodita* is one of the most frequently reported in these birds (HODOVÁ et al., 2008). Previously, heavy infections of *A. hermaphrodita* were found in two female slender-billed parakeets that died at the Chilean National Zoo in Santiago (GONZÁLEZ-ACUÑA et al., 2007). This parasite is considered one of the most common parasites found among



Figure 1. *Ascaridia hermaphrodita*: posterior end of male. Scale: 0.2 mm.

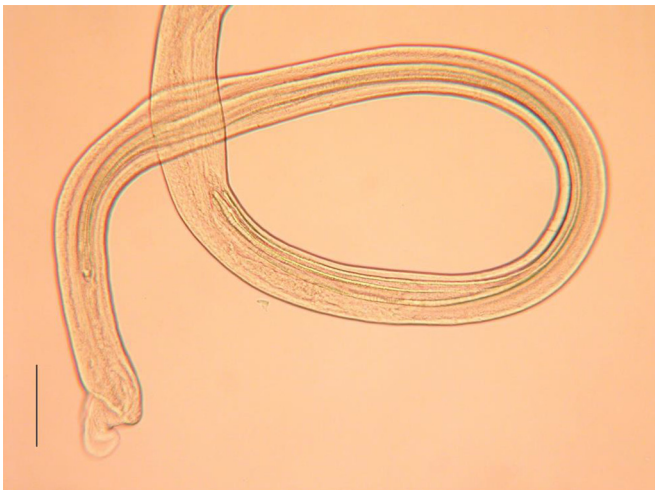


Figure 2. *Capillaria plagiatica*: posterior end of male. Scale: 0.1 mm.

parrots in captivity (HODOVÁ et al., 2008), likely due to the characteristics of this parasite's life cycle (direct cycles) and the high resistance of its eggs (ATKINSON et al., 2008). Hartwich & Tscherner (1979) also recorded *A. platyceri* in a captive Austral parakeet in Germany. In this study, *A. hermaphrodita* was found in the slender-billed parakeets obtained from the Wildlife Rehabilitation Center, CODEFF (Comité Nacional Pro Defensa de la Fauna y Flora) (Table 1); to date, the presence of this nematode in the

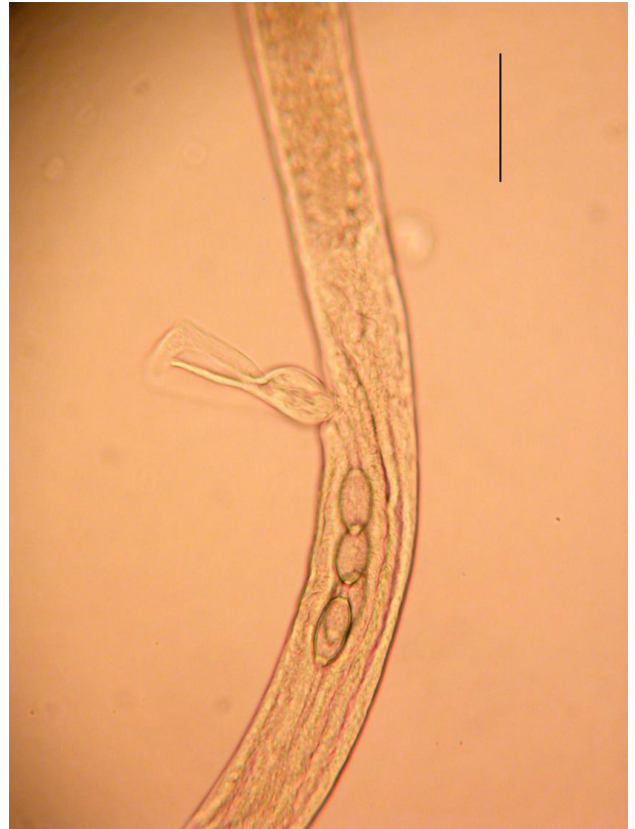


Figure 3. *Capillaria plagiatica*: vulvar region of female. Scale: 0.1 mm.

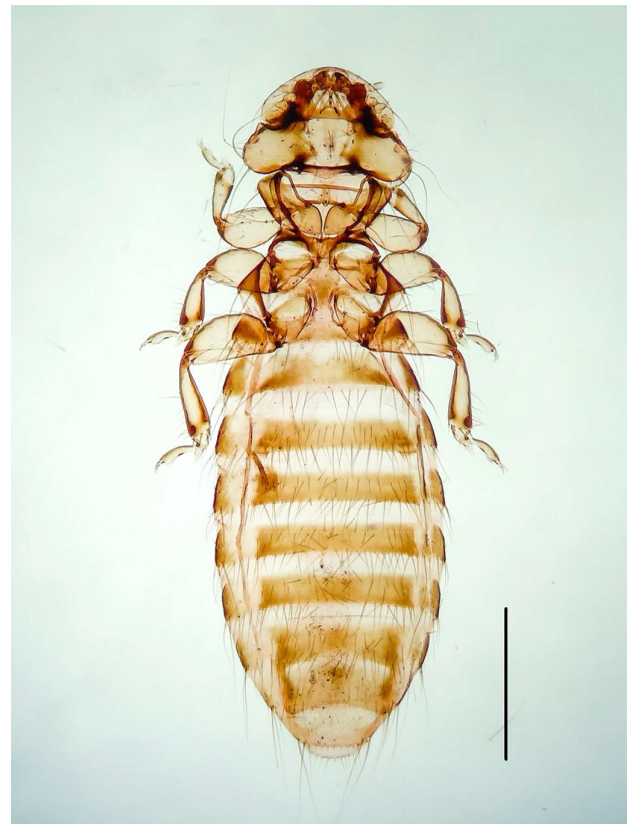


Figure 4. *Heteromenopon macrurum*: female. Dorsal view. Scale: 0.5 mm.



Figure 5. *Heteromenopon macrurum*: male. Dorsal view. Scale: 0.5 mm.

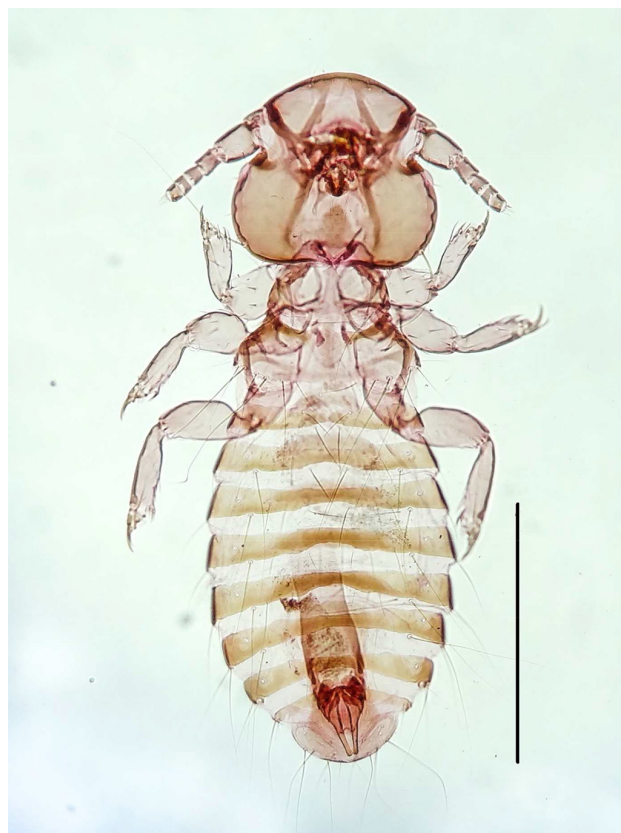


Figure 7. *Paragoniocotes enicognathidis*: male. Dorsal view. Scale: 0.5 mm.



Figure 6. *Psittacobrossus patagoni*: female. Dorsal view. Scale: 0.5 mm.

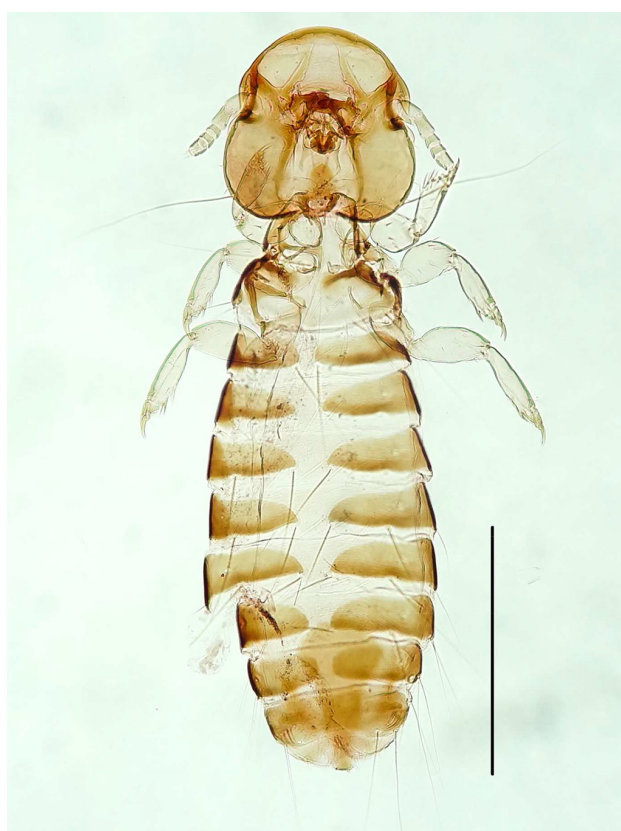


Figure 8. *Paragoniocotes enicognathidis*: female. Dorsal view. Scale: 0.5 mm.



Figure 9. *Pararalichus hastifolia*: female. Ventral view. Scale: 0.25 mm.



Figure 11. *Genoprotolichus major*: female. Ventral view. Scale: 0.25 mm.

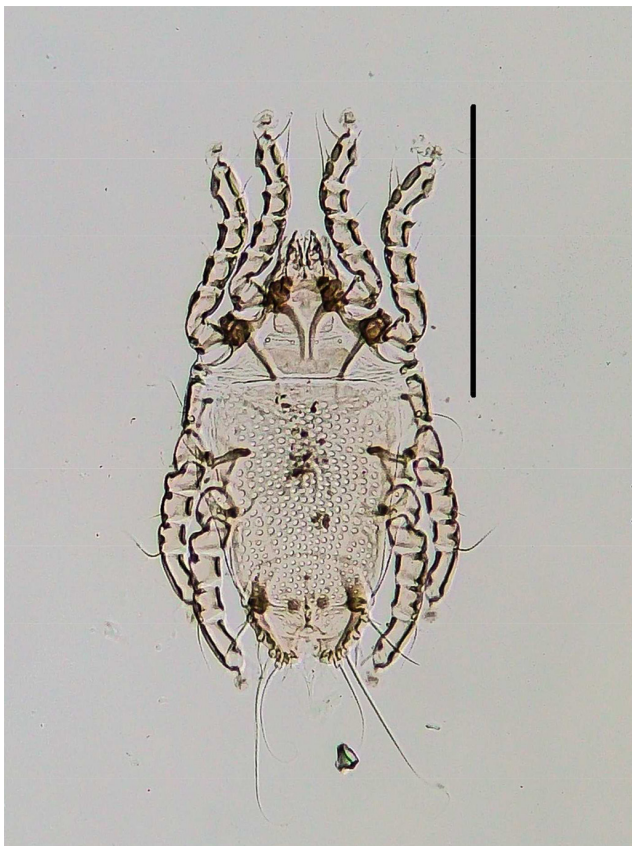


Figure 10. *Pararalichus hastifolia*: male. Ventral view. Scale: 0.25 mm.



Figure 12. *Genoprotolichus major*: male. Ventral view. Scale: 0.25 mm.

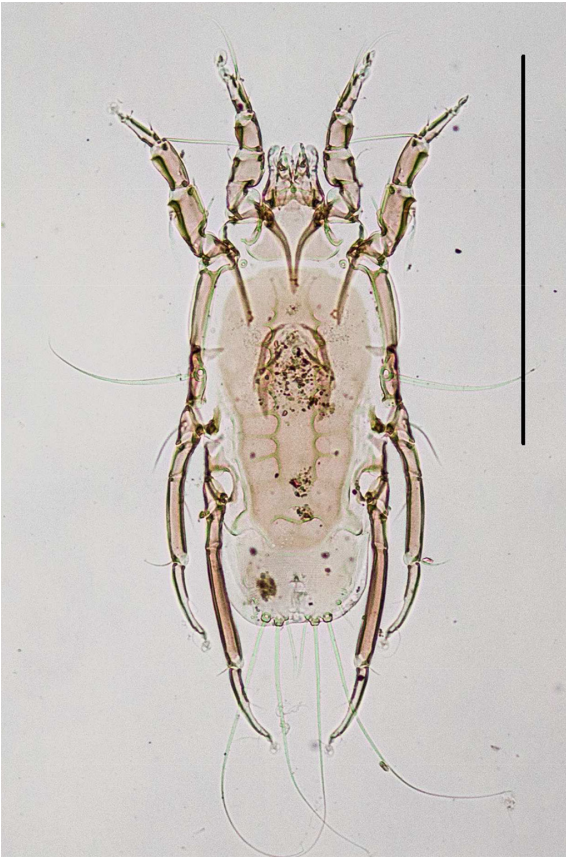


Figure 13. *Protonyssus* sp.: female. Ventral view. Scale: 0.25 mm.

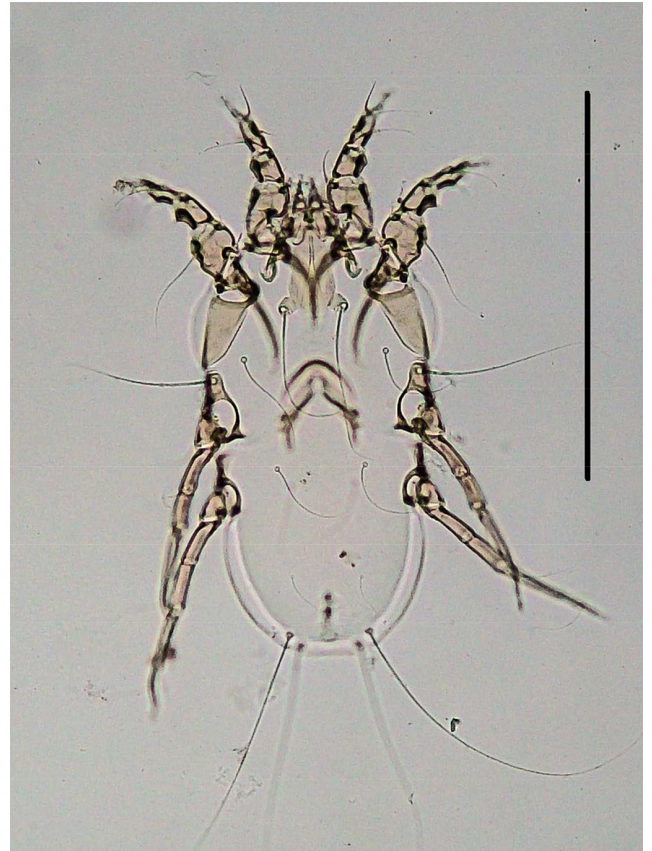


Figure 15. *Fainalges* sp.: female. Ventral view. Scale: 0.25 mm.



Figure 14. *Protonyssus* sp.: male. Ventral view. Scale: 0.25 mm.

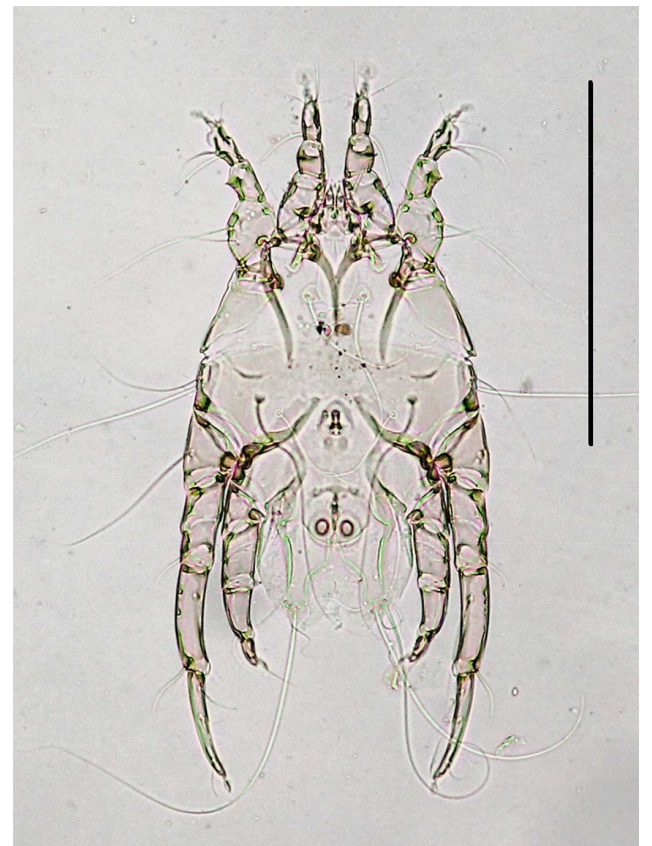


Figure 16. *Fainalges* sp.: male. Ventral view. Scale: 0.25 mm.



Figure 17. *Eurydiscalges* sp.: female. Ventral view. Scale: 0.25 mm.

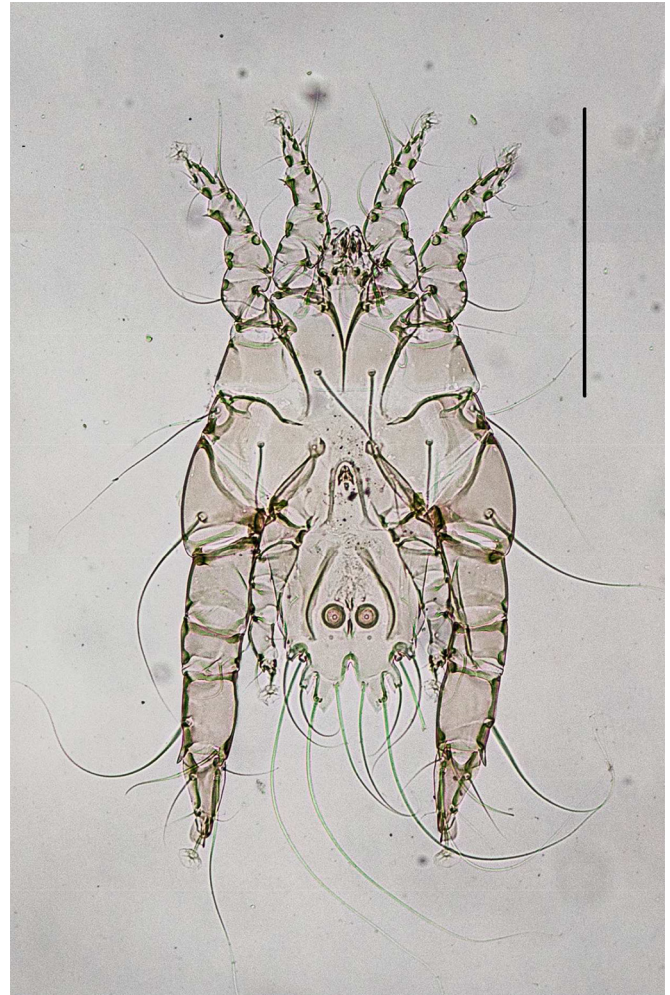


Figure 18. *Eurydiscalges* sp.: male. Ventral view. Scale: 0.25 mm.

wild in Chile has not been confirmed. The high intensity of this parasite in dead birds highlights the need to perform additional studies to determine the importance of this parasite in the ecology of these two types of parakeets.

The nematode *C. plagiaticia* (Nematoda: Trichuridae) was originally described by Freitas & Mendonça (1959) on the basis of samples collected from cactus parakeets (*Aratinga (Eupsittula) cactorum caixana* Spix, 1824) in Brazil. *Capillaria plagiaticia* is considered to be specific to psittacids (KAJEROVÁ & BARUS, 2005). The present finding in this study is the first record of this nematode in the austral parakeet, and it also represents its first record in Chile.

Phthiraptera

The genus *Heteromenopon* Carriker, 1954 (Amblycera: Monoponidae) is comprised of fifteen species of chewing lice that are exclusive to Neotropical psittacids (Psittacinae), and Australian-New Zealand psittacids from the tribes Nestorini (Nestorinae) and Platycercini (Psittacinae) (CICCHINO & GONZÁLEZ-ACUÑA, 2009). Nevertheless, *H. macrurum* was described from *Falco sparverius* Linneo, 1758 (Falconiformes: Falconidae) and *Sterna paradisaea* Pontoppidan, 1763 (Charadriiformes: Sternidae) captured in the

region of Los Ríos, Chile (MEY et al., 2002; PALMA, 1975). However, according to Price & Beer (1967), their original descriptions were based on erroneous identification of the hosts. Palma (1975) later proposed *Myiopsitta monachus monachus* Boddaert, 1783 as a true host. *Heteromenopon macrurum* has been also reported on burrowing parrot *Cyanoliseus patagonus* Vieillot, 1818 and on the austral parakeet in Argentina and Chile; and on the slender-billed parakeet in Chile (ARAMBURÚ et al., 2003; CICCHINO & GONZÁLEZ-ACUÑA, 2009; MEY et al., 2002).

The genus *Psittacobrossus* Carriker, 1954 (Amblycera: Monoponidae) contains 20 species, all of which are parasites of New World parrots. The description of *P. patagoni* was based on samples obtained from a burrowing parrot, *Cyanoliseus patagonus bloxami* Olson, 1995 from Angol, Chile (PRICE & BEER, 1968). This parasite has also been found on *C. p. patagonus* in Argentina, and on the austral parakeet in Chile and Argentina (ARAMBURÚ, 2012; CICCHINO & GONZÁLEZ-ACUÑA, 2009). Thus, our finding is the first record of *P. patagoni* on the slender-billed parakeet.

The genus *Paragoniocotes* Cummings, 1916 (Ishcnocera: Philopteridae) has more than 30 species (PRICE et al., 2003); the majority are exclusive to psittacid hosts (MEY et al., 2002).

Paragoniocotes enicognathidis was recently described by Cicchino & González-Acuña (2009) on austral and slender-billed parakeets from Argentina and Chile. Thus, *P. enicognathidis* has only been recorded on parrots of the genus *Enicognathus*.

Acari

The mite *Pararalichus hastifolia* (L Pterolichoidea: Pterolichidae) is considered specific to parrots of the genus *Enicognathus* (ATYEO, 1989b). This species was originally described by Mégnin & Trouessart (1884) on the austral parakeet and it was named *Pterolichus* (*Pterolichus*) *hastifolia*. Atyeo (1989a) redescribed this species and assigned it to the genus *Aralichus* Gaud, 1966; in addition, he found it on the slender-billed parakeet from Chiloé, Chile. Later, Atyeo (1989b) created the genus *Pararalichus*, and included this species within this category. This genus is associated with various parrots from the New World. *Pararalichus hastifolia*, as well as all pterolichids, are specialized to inhabit the ventral surface of feathers with large vanes – i.e., the flight and covert feathers of the wing, as well as the tail feathers (MIRONOV & DABERT, 2007).

Mites of the genus *Genoprotolichus* Gaud and Atyeo, 1996 (Pterolichoidea: Pterolichidae) live on the longest wing feathers of psittacid birds (GAUD & ATYEO, 1996a, b) and they are comprised in four species. *Genoprotolichus major* was described by Favette & Trouessart (1904) on austral parakeets from Patagonia and Tierra del Fuego, Chile; it was further recorded in this country on the subspecies *Enicognathus ferrugineus minor* Chapman, 1919 in Mafil, Valdivia, and Melinka, Chiloé (CUERVO & PÉREZ, 2009). The present study represents the first record of *G. major* on the slender-billed parakeet.

The feather mite genera *Protonyssus* Trouessart, 1916, and *Fainalges* Gaud and Berla, 1964 (Analgoidea: Xolalgidae) belong to the subfamily Ingrassiinae, and they represent two of three ingrassine genera known to infest birds of the order Psittaciformes (GAUD & ATYEO, 1981). *Fainalges* and *Protonyssus* are exclusively associated with parrots, while species of the third genus, *Dubininia* Vassilev, 1958, live on parrots of the Old World and also on birds of the orders Falconiformes and Cuculiformes.

The genus *Protonyssus* currently includes four species; three of them are known from New World parrots: *Protonyssus larva* Trouessart, 1885, *P. brevis* Trouessart, 1885 and *P. proctorae* Mironov, Dabert and Ehrnsberger, 2005; the fourth species, *P. interifolia* Trouessart, 1885, was described from *Bolbopsittacus lunulatus* Scopoli, 1786 from the Philippines (MIRONOV et al., 2005; TROUESSART, 1885).

The genus *Fainalges* currently includes thirteen species of New World parrots from the genera *Aratinga* Spix, 1824; *Deroptyus* Wagler, 1832; and *Conuropsis* Salvadori, 1891 (MIRONOV et al., 2005; PEREZ, 1995). The genus *Fainalges* is considered to be restricted to parrots from this part of the world.

The finding of two supposedly new ingrassine species, *Protonyssus* sp. and *Fainalges* sp., on the austral and slender-billed parakeets represents new host–parasite associations, both for these birds and in Chile.

The feather mite genus *Eurydiscalges* Faccini, Atyeo and Gaud, 1976 (Analgoidea: Psoroptoididae) belongs to the subfamily Pandalurinae (FACCINI et al., 1976; MIRONOV, 2004) and is restricted to psittaciform hosts. This genus currently includes four species, described by FACCINI et al., 1976, from four parrots of the New World: *E. opistoproctus* Faccini, Gaud & Atyeo 1976 from *Pionites melanocephalus* Linnaeus, 1758; *E. phalacrus* Faccini, Gaud & Atyeo 1976 from *Ara severus* (Linnaeus, 1758); *E. pyrrhurae* Faccini, Gaud & Atyeo 1976 from *Pyrrhura leucotis* Kuhl, 1820; and *E. pedanossomae* Faccini, Gaud & Atyeo 1976 from *Deroptyus accipitrinus fuscifrons* Hellmayr, 1905. Thus, the finding of a supposedly new *Eurydiscalges* sp. on the austral and slender-billed parakeets represents a new host–parasite association for these birds in Chile.

Some feather mite specimens represented by junior preimaginal instars (larvae and protonymphs) were identified only at the family level (Table 2; Pterolichidae gen. sp.). Given the present state of systematics for most feather mite families, the identification of preimaginal instars up to the species and genera level is quite difficult because they are understudied.

Conclusion

The list of ecto- and endoparasites reported from the austral and slender-billed parakeets in Chile includes the following species: *Pararalichus hastifolia*; *G. major*; *Protonyssus* sp.; *Fainalges* sp.; *Eurydiscalges* sp.; *H. macrurum*; *Psittacobrosus patagoni*; and *Paragoniocotes enicognathidis*. Additionally, the nematodes *C. plagiaticia* and *Ascaridia platyceri* were found in the austral parakeet, while *A. hermaphrodita* was recorded in the slender-billed parakeet.

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